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## ХУРНАЛ ВЪВЕДЕНИЕ ИЕРВНОТ ДЕРТЕМЪНОСТУ

INTERACTION OF ANALYSERS IN THE FORMATION  
OF MOTOR FOOD CONDITIONED REFLEXES

ЖУРНАЛ ВЪВЕДЕНИЕ S Adryanov

Vol 10

No 6

1960

Institute of Brain, USSR, Academy of Medical Sciences, Moscow

Complete bilateral disconnection of the cortical territories of the skin and optical analysers was carried out in dogs, following the elaboration of motor and secretory food conditioned reflexes to single and complex stimuli. The operation did not prevent the possibility of joint activity of the disconnected analysers; the positive conditioned reflex to a complex of cutaneous (mechanical stimulation) and optical (an object or light) stimuli was preserved. After the operation, the stability of the conditioned reflexes to single and complex inhibitory stimuli was considerably lowered.

Bilateral frontal lobotomy in dogs with disconnected nuclei or the optical and skin analysers produced a prolonged serious disturbance of conditioned reflexes both to single and complex stimuli. The lowered stability of positive and particularly of inhibitory reflexes may be due not only to the disconnection of analyser nuclei, but also to a lesion during the operation on the central projection pathways of the analysers and secondary changes in the cortex and subcortical formations.

1958

INDIVIDUAL PROPERTIES OF ELECTRICAL PROCESSES IN THE  
CORTEX AND THE BRAIN STEM STRUCTURES IN DOGS

Same as above

Vol 11

No 1

1961

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Electrical processes were studied in the specific auditory (medial geniculate body, corpus quadrigeminum) and non-specific (reticular formation) structures of the mid-brain and the cerebral cortex in ten dogs. Changes in electrical activity in the specific and non-specific system of the mid-brain level in the course of habituation to the experimental conditions and under the influence of external stimuli have common features in each animal (wide irradiation). At the same time differences were recorded in the electrical activity of individual animals. In some dogs the amplitude and frequency of electrical oscillations in the cortical and particularly the brain-stem structures, varied in a wide range, while in others the changes were slightly pronounced under the same conditions. The similarity of electrical processes in different brain systems of the given animal proves that the individual peculiarities of the nervous system are inherent in all the brain structures. Elaboration and stabilization of defensive conditioned reflexes is attended by a redistribution of activity in the specific and non-specific systems of the brain with a gradual concentration of the processes in the specific systems of the brain-stem. The concentration

sets in individual dogs after a different number of pairings and proceeds at different levels of the processes.

1959

*Same as below Vol 11, No 3, 1961*

ELECTROENCEPHALOGRAPHIC ANALYSIS OF THE ACTIVITY  
OF DIFFERENT LAYERS OF THE CEREBRAL CORTEX DURING  
CONDITIONED REFLEXES

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of Medical Sciences, Moscow

Defensive conditioned reflexes elaborated to rhythmic acoustic and photic stimuli were studied in dogs with 30-40 diam. electrodes chronically implanted in different layers of the cortex of the acoustic, visual, cutaneous and motor analysers. It has been found that during the formation of defensive conditioned reflexes the process of excitation unites the neurons of all cortical links of the reflex into one functioning system; the process is predominantly localized in the II and IV layers of the analyser, where the signal stimuli are addressed; in the II and IV layers of the cutaneous analyser and in the III and V layers of the motor analyser. Internal inhibition (differentiation, extinction), like the process of excitation, simultaneously envelope cortical structures of those analysers, between which conditioned connection has been elaborated, predominantly in the same layers of the cortex.

1961

ЖУРНАЛ ВЫСШЕЙ НЕРВНОЙ ДЕЯТЕЛЬНОСТИ, VOL 10  
METHODS OF RECORDING THE ELECTRICAL ACTIVITY OF  
INDIVIDUAL LAYERS OF THE CEREBRAL CORTEX IN CHRONIC  
EXPERIMENTS  
NO 4  
1960

M Ya Rabinovich and I I Glaser

Institute of the Brain, USSR Academy of Medical Sciences, Moscow  
1959

Серия биологическая

№3  
1958 313-326

## A STUDY OF THE CONTRACTIONS OF AN ISOLATED MUSCLE FIBER

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A study was carried out of the change in the character of responses to single condenser discharges of an isolated striated frog muscle fiber surviving in Ringer saline. The effect of some chemical substances was also tested, viz. of different concentrations of potassium chloride, ethyl alcohol, Ringer saline without Ca-ions, sodium citrate and -dinitrophenol.

All the above agents call forth substantially similar changes in the contractility of the fiber. That is to say, with aggravation of its functional state the fiber does not more respond to stimulation by only non-graded contractions which propagate along the fiber, but begins to exhibit local graded contractions which at a certain stage of alteration become the only kind of response of the muscle fiber to any strength and length of stimulation.

After the disappearance of propagating responses the plots of the magnitude of local contraction as a function of the strength of stimulation acquire a smooth S-shape their position in the system of coordinates depending on the functional state of the fiber. At earlier stages of alteration the smooth course of the curves at a definite strength of stimulation is disturbed owing to the appearance of non-graded propagating responses.

The existence of two types of muscle response, their dynamics as associated with a change in the functional state of the fiber, the S-shaped curves relating the magnitude of the local contraction to the strength of stimulation--all these data justify the applicability of the principal statements of the gradual theory of excitation as suggested by Nasonov, to the contractile reactions of the muscle tissue.

1958

ЦИТОЛОГИЯ

Vol 4, No 2, 1962

THE DISTRIBUTION OF A VITAL DYE (NEUTRAL RED) BETWEEN THE  
GIANT AXON OF SEPIA AND SEA WATER

A A Vereninov, N N Nikolsky and D L Rosental

1962

# ЖУРНАЛ ВЫСШЕЙ НЕРВНОЙ ДЕЯТЕЛЬНОСТИ

Vol 10, No 6, 1960

IMPROVED STEREOTAXIC DEVICE FOR SMALL ANIMALS

R M Meshersky

Institute of Higher Nervous Activity, USSR Academy of Sciences,  
Moscow

1960

## ЦИТОЛОГИЯ

Vol 4, No 1, 1962

CORRELATION BETWEEN THE INTENSITY OF LIGHT SCATTERING,  
CONCENTRATION OF SOME AGENTS AND DURATION OF THEIR ACTION IN  
NERVE CELLS

S V Levin

1962

*Same* Vol 3, No 4, 1961  
CHANGES OF DISPERSION DEGREE OF PROTOPLASMA COLLOID PARTICLES OF  
NERVE CELLS UNDER THE ACTION OF THE SOLUTIONS OF QUININE  
SULPHATE, EGG ALBUMIN AND ETHYLURETHAN

S V Levin

1961

## ВЕСТНИК ЛЕНИНГРАДСКОГО УНИВЕРСИТЕТА

No English Title

Article by S. A. Krolenko

Summary

No 15  
1959

The change in the excitability of the isolated striated muscle fibres in Ringer solution, while mechanically injured, under the action of Ringer solution without calcium ions and of different concentrations of KCl, sodium citrate, -denitrophenol has been investigated. The investigation shows that the character of changes in fibre excitability depends both on the duration of the employed stimuli and on the kind of fibre contraction (local or propagating) taken as the criterion of the threshold. Under the action of all the test agents a number of common properties has been observed in the change of the muscle fibre excitability: sudden disappearance of excitability determined by propagating contractions; at a certain stage of the alteration an increase of rheobase excitability estimated by the local contractions at simultaneous decrease of excitability to stimuli of small duration; at the late stages of the alteration gradual decrease of the "local" excitability to stimuli of any duration.

The change of the excitability proves to be in all the cases closely connected with that of the magnitude and the character of muscle fibre contractions, thus allowing us to consider the obtained data in the light of Nasonov's gradual theory of excitation.

# БЮЛЛЕТЕНЬ ЭКСПЕРИМЕНТАЛЬНОЙ БИОЛОГИИ И МЕДИЦИНЫ

№ 9, 1960

## THE EFFECT OF EXTIRPATION OF THE VAGUS CORTICAL REPRESENTATION ZONES UPON INTEROCEPTIVE CONDITIONED REFLEXES FROM THE STOMACH AND INTESTINE

A N Sovetov, V N Chernigovsky

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Experiments were performed on 3 dogs. The state of extero- and interoceptive conditioned reflexes was studied prior to and after the removal of the vagus cortical representation zones. Extirpations of these areas was associated with the disturbance of conditioned reflexes from the stomach and had no effect upon those coming from the intestine, innervated by the splanchnic nerve. Extirpation of a parietal lobe area control operation performed in one of the dogs, caused no changes in the exterointeroceptive conditioned reflexes. Removal of the afferent vagus representation zones in dogs with denervated stomach was associated with prolonges and fluctuating disturbance of the interoceptive reflexes from the stomach.

1960

## ЖУРНАЛ ВЫСШЕЙ НЕРВНОЙ ДЕЯТЕЛЬНОСТИ

### STUDY OF THE ROLE OF INTEROCEPTIVE SIGNALIZATION IN THE FEEDING BEHAVIOUR OF ANIMALS

V N Chernigovsky  
Leningrad

Vol 10  
№ 3  
1960

In experiments the dogs had a choice of several solutions containing milk and various amounts of sodium chloride (1.0, 2.5 and 3.5 per cent). The animals readily drank the solutions passing on from the less concentrated to more saturated ones. The infusion of 300 ml of a 5 per cent sodium chloride solution into the stomach through a fistula caused the animal in a few minutes (3-8) to refuse to take the most concentrated milk solutions of sodium chloride. When the sodium chloride solution was removed from the stomach, the former attitude to milk sodium chloride mixtures was restored.

The change in the attitude to such solutions was not a result of thirst or mechanical stimulation of the stomach receptors by the infused solution. The choice of the milk sodium chloride mixtures disappears or is disturbed, after the section of the vagus nerves under the diaphragm, which testifies to the reflex nature of the phenomenon in question. If a 27 per cent glucose or saccharose is substituted for the 5 per cent sodium chloride solution, the choice of the milk-sodium chloride mixtures is not disturbed.

1960

## Структура условных рефлексов на одновременный комплексный раздражитель 1025

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## ЖУРНАЛ

BYIGWEY NERVOH DEYATELYNOSTU, VOL II  
 ON THE STRUCTURE OF CONDITIONED REFLEXES  
 TO A SIMULTANEOUS COMPLEX STIMULUS № 6, 1964

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The paper deals with the peculiarities of formation of motor alimentary reflexes to a simultaneous complex stimulus whose components are almost similar in their intensity. The results obtained are compared with the results of the elaboration of conditioned reflexes to positive and differentiation single stimuli.

It was found that in the course of elaboration of a simple functional mosaic involving a positive stimulus and an inhibitory stimulus which are directed either to the visual or to the cutaneo-mechanical analyser, the inhibitory process invariably exerts influence on the excitatory process, and vice versa. In case of a systematic extinction of the components of a simultaneous complex stimulus (a «toucher» and a moving figure) the conditioned reflex to the latter is usually not inhibited. Extinction of a single component of the complex does not exert any substantial influence on the dynamics of the conditioned reflexes to the other component.

The analysis of data concerning the formation of conditioned reflexes to a simultaneous complex emphasizes the role of summation of the excitatory process evoked by conditioned stimuli with the unconditioned excitation. This summation, apparently, takes place on the level of both the cortical and subcortical divisions of the food centre. However, certain data allow to draw the conclusion that the transformation of the summation reflex into a synthetic reaction lies beyond the bounds of the summation processes, it may be explained by the process of internal inhibition which develops along the pathways leading from various divisions of the stimulated analysers to the «centres» of the alimentary unconditioned reflex, as well as within the «centres» themselves.

АКАДЕМИЯ НАУК СССР

ЖУРНАЛ  
ВЫСШЕЙ НЕРВНОЙ  
ДЕЯТЕЛЬНОСТИ

им. И. П. ПАВЛОВА

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ской активности в структурах ствола мозга, стадия генерализованной депрессии электрической активности крайне растянута. Она сменяется стадией в форме двухфазного электрографического ответа, где первая фаза характеризуется депрессией, а вторая — возрастанием активности, охватывающим преимущественно системы замыкающихся анализаторов.

4. Полученные данные свидетельствуют о том, что пути проведения возбуждения и объем охвата им структур ствола мозга находятся, при прочих равных условиях, в зависимости от силовых характеристик действующего сигнала.

Поступило  
10 V 1961

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#### DYNAMICS OF ELECTRICAL PROCESSES IN MEDULLAR AND CORTICAL STRUCTURES OF DOGS' BRAIN DURING REFLEXES TO STIMULI OF VARIOUS INTENSITY

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Results are given of studying the dynamics of changes in the electric potentials of the acoustic analyser (cochlear nuclei of the medulla, the middle ectosylvian gyrus), of the motor analyser (nuclei of the fasciculi gracilis and cuneatus and the sigmoid gyrus) as well as of the reti-

cular formation of the medulla during unconditioned and conditioned defensive reflexes in dogs to acoustic stimuli of varying intensity. It has been found that reflexes to weak acoustic stimuli, which before reinforcement did not result in noticeable changes in the EEG are accompanied by a generalized drop in electrical activity which is followed by its generalized rise as the pairings are repeated. Subsequently, a concentration of processes takes place in the system of coupling analysers, which is particularly pronounced in subcortical links of the acoustic analyser and in cortical components of the motor analyser. In the case of elaboration of reflexes to more intensive sound stimuli which before pairing caused a depression of electrical activity in the structures of the brain stem, the stage of generalized depression of electrical activity is greatly prolonged. This stage is followed by one with more pronounced processes in the main systems of the analysers in the form of a two-phase electrographic response in which the first phase consists in a depression of activity, and the second one, an increase in activity, covering predominantly the systems of coupling analysers.

The data obtained testify that the ways of excitation transmission and its spreading in the structures of the brain stem depend, other conditions being equal, on the strength of the acting signal.

A. H. POITSEK

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## METAMORPHOSES OF PRIMARY RESPONSES - 1956

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## Summary

Experiments were carried out on normal adult cats. The potentials were recorded through the bone of the skull which was thinned without perforating it (Roitbak, 1954, 1956): one recording electrode—the active—was placed on the acoustic projection area, the second—outside this area.

Nambutal anaesthesia. With deep narcosis clicks evoked primary responses in the form of positive potentials, not complicated by additional oscillations (Fig. 2, B and 3, A).

A waking state. In a waking state of the animal clicks evoked more complicated effects: after the initial positive potential there arose a second positive potential (Fig. 2), or a negative potential (Fig. 3, B); after the characteristic  $+$ —complex sometimes a series of quick oscillations arose (Fig. 3, B and D). In a waking state the latency of the primary responses is usually a little less than with deep anaesthesia; the amplitude and duration of the initial positive potential is less than with narcosis (cf. Fig. 2, A, B; 3, A, B); the primary responses are extremely variable.

Natural sleep. In deep natural sleep the primary responses were restricted to the appearance of positive potentials of considerable amplitude (Fig. 3, E). Latency of the primary response was a little more than in a waking state.

Conditioned reflex. Clicks, after becoming (as a result of combination with food) a conditioned stimulus, caused in this new role a bio-electrical reaction, differing markedly from the one caused when the given stimulation was "indifferent". With the action of conditioned stimulation

As gradually increasing beta-like rhythm arose (Fig. 4) the primary responses were weakly expressed: the initial positive potential was often reduced to quick oscillations of small amplitude.

**Extinction.** In the course of acute extinction of a conditioned reflex, i.e. when the conditioned reflex was not reinforced by an unconditioned stimulus, the beta-rhythm evoked by the conditioned stimulus weakened progressively; on the other hand, the primary responses were better expressed (Fig. 5, B). With complete extinction of the reflex on each stimulus there arose a primary response in the form of a positive potential followed by an alpha-like wave (Fig. 5, C and D). In the intervals between the stimuli slow oscillations of the potential predominated (Fig. 5, A).

An analysis of the given facts was based on the following theoretical assumptions:

1. Changes in the latency of the primary responses bear witness to changes in the excitability of the neurons of the subcortical relays.
2. The initial positive potential reflects local excitation of the neurons (chiefly the pyramidal ones) of the IV and III layers, arising under the action of impulses from specific afferents. On the surface of the cortex there is electrical manifestation of the excitation only of those neurons of the IV and III layers, the dendrites of which ascend to the surface of the cortex (Fig. 1, 1); excitation of the neurons with a short axon may be revealed owing to a secondary activation of the pyramidal neurons, with the excitation of their cell bodies (by means of neurons 2 or 5) an additional positive potential arises; with the excitation of the apical dendrites (by means of neurons 3 and 4) a negative potential arises.
3. According to data given by Beritoff and his collaborators (Beritoff, 1941, 1956; Beritoff and Roitbak, 1955; Roitbak, 1955) the apical dendrites of the pyramids do not conduct excitation; in response to impulses coming to them through the synapses local non-conducted excitation arises in them; excitation of the apical dendrites is associated with inhibition of the given neurons. But according to the usual ideas, with excitation of the cell bodies of the pyramids of the IV layer, excitation is then conducted antidromically along the apical dendrites to the I layer and is recorded in the form of a negative phase of the primary response (Chang, Bishop, Burns and others).
4. It was assumed that the mechanism of the initiation of conducted excitation in the cortical neurons is the same as in spinal motoneurons.

**Conclusion.** Metamorphoses of the primary responses reflect the slightest changes in the excitability of the neurons of the IV and III layers ("the sensitive sphere" of the cortex). Normally these neurons become excited very easily, especially the neurons with a short axon; under the action of a sufficiently intensive volley of afferent impulses local excitation arises in them which develops into a discharge of cells soon after its appearance. The quicker the discharge of these neurons arises, the less will be the duration of the initial positive potential which can be reduced to an extremely short oscillation. When as a result of these or other causes (anaesthesia, inhibition) excitability of the neurons of the IV and III lay-

ers decreases, then under the influence of these same impulses local excitation develops in them to the full extent and then dies away.

Increase of excitability of neurons of IV layer

Nembutal narcosis	Natural sleep	Extinction of condition- ed reflex	Waking state	Conditioned reflex-positive activity
Peripheral stimulation causes chiefly local excitation of the neurons of IV layer			Peripheral stimulation causes chiefly a discharge of the neurons of IV layer	

The process of inhibition lies at the basis of the sharp decrease in excitability of the neurons of the IV layer in the focus of conditioned stimulation during acute extinction. An analysis of the bioelectrical phenomena makes it possible to conclude that inhibition of the activity of these neurons does not take place directly under the action of impulses which are caused by conditioned stimulation. It is connected with the arising of alpha-like waves evoked by unreinforced conditioned stimuli. May be as a result of the excitation of neuronic circuits: cortex-reticular formation of the diencephalon.

ных нейронов в соответствующем участке анализатора, возникновение медленных колебаний потенциала типа альфа-волн. Следствием этого является уменьшение возбудимости системы пирамидных нейронов данного анализатора, а затем и нейронов IV и III слоев с коротким аксоном (см. Беритов и Ройтбак, 5), т. е. торможение начального пункта временных связей условного рефлекса. Таким образом, в основе острого угасания условного рефлекса лежит процесс торможения (что уже давно установлено Павловым), но, согласно этой гипотезе, торможение деятельности нейронов IV и III слоев происходит не непосредственно под влиянием входящих к ним импульсов возбуждения, как это обычно предполагается. С данной точки зрения легко объясняется и явление вторичного угасания: при иррадиации возбуждения на все больший участок сетевидного образования таламуса, все большие корковые территории будут захвачены процессом торможения.<sup>1</sup>

Итак, метаморфозы первичных ответов тонко отражают изменения возбудимости нейронов IV и III слоев коры: на основании степени возбудимости нейронов IV и III слоев рассмотренные физиологические состояния коры можно расположить в следующий ряд:

Небуталовый наркоз	Естественный сон	Острое угасание условного рефлекса	Бодрствование	Условнорефлекторная (положительная) деятельность
Периферическое раздражение вызывает преимущественно местное возбуждение нейронов IV слоя		Периферическое раздражение вызывает преимущественно разряд нейронов IV слоя		

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<sup>1</sup> Аналогичное объяснение можно дать и явление угасания ориентировочного рефлекса.